MASTER OF SCIENCE
IN
SOFTWARE ENGINEERING

A METHODOLOGY FOR DEVELOPING TIMING CONSTRAINTS FOR THE BALLISTIC MISSILE DEFENSE SYSTEM

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The Department of Defense (DoD) is developing a Ballistic Missile Defense System (BMDS) based on a layered defense that employs complementary sensors, weapons, and C2 elements, integrated by software into a system-of-systems to engage and destroy threat ballistic missiles through all phases of flight. Inherent to the ultimate success of the BMDS will be the timely execution of the kill chain process against threat ballistic missiles.

In this thesis, the Unified Software Development Process (USDP) is applied, utilizing the BMDS as a case study to investigate a means to identify and validate timing behaviors and constraints of system-of-systems. In particular, the information exchange needed for processors to share, collaborate, fuse, and distribute sensor information in a distributed sensor network is examined, and modeling and simulation to provide insight into the timing aspects of interactions among subsystems comprising a system-of-systems is utilized. The case study will involve deriving and documenting system and software requirements, developing a test-ready model for representing the timing requirements, and then validating this model through the use of an OMNET++ simulation. The simulation will then be used to provide feedback to further refine the system requirements and the functional specifications of the subsystems.

KEYWORDS: Software Engineering, System-of-Systems, Ballistic Missile Defense System, BMDS, Sensor Fusion, Collaborative Fusion, Modeling, Simulation, OMNeT++, UML-RT, Real-Time Constraints, Software Requirements, Kill Chain, Timing Requirements, Unified Software Development Process, USDP